



SOURCES & LOADS OF NITRATE TO THE WEKIVA RIVER SYSTEM

PRELIMINARY ASSESSMENT



**FLORIDA DEPARTMENT
OF ENVIRONMENTAL
PROTECTION**



**MACTEC
ENGINEERING AND
CONSULTING**



**ST. JOHNS RIVER
WATER MANAGEMENT
DISTRICT**

WEKIVA BASIN NITRATE SOURCING STUDY

- Special legislative appropriation to Florida Dept. of Environmental Protection in 2006 (\$250,000)
- The Department contracted with St. Johns River Water Management District to implement a “Phase 1” assessment** using existing data and models (max. of \$100,000)
- SJRWMD used the services of their contractor - MACTEC Engineering and Consulting (Gainesville, FL)
- Deficiencies identified in Phase 1 would be addressed as part of a follow-up Phase 2 effort

** Constraints: report ready by start of 2007 Session & available for Florida Dept. of Health to use

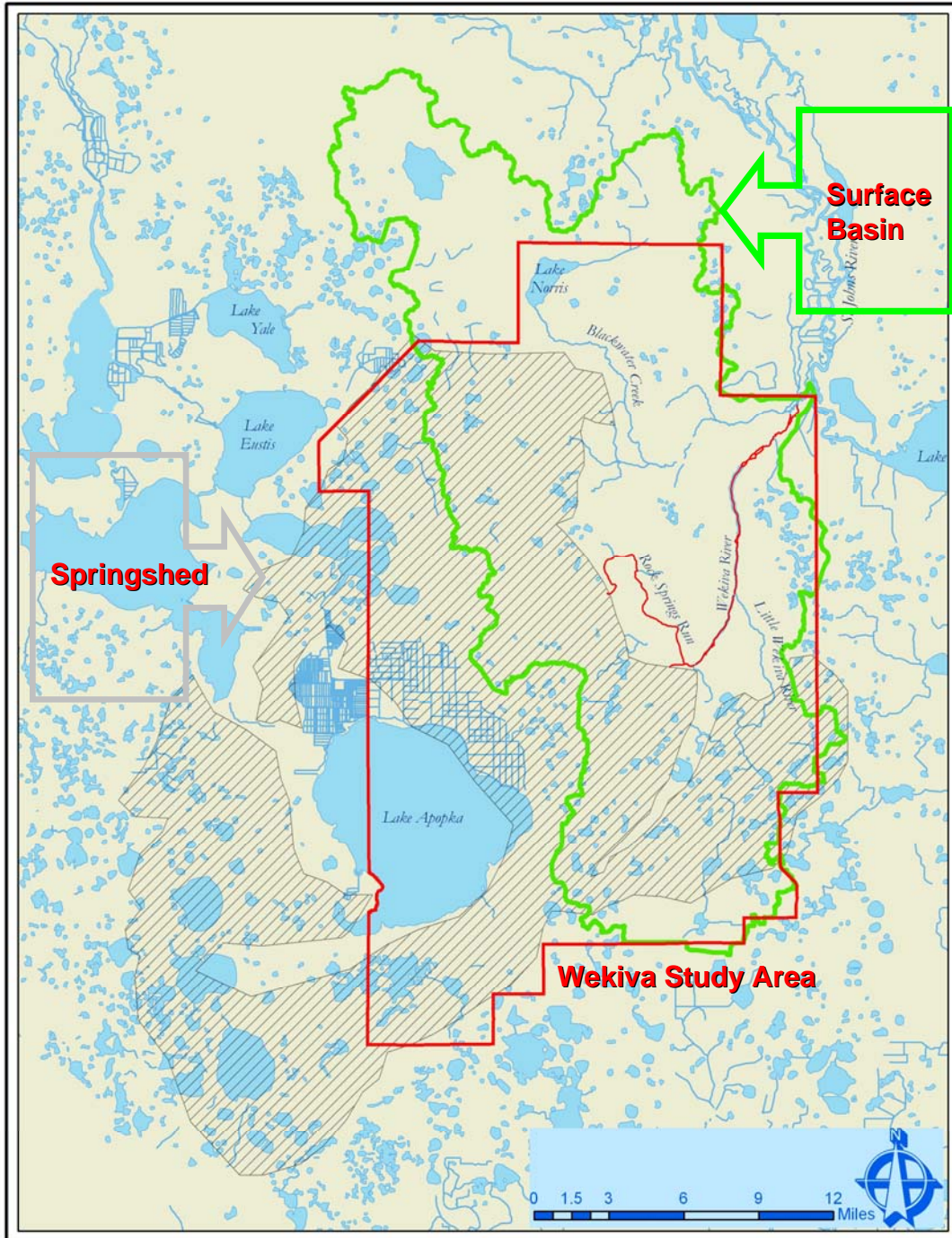


MACTEC TASKS

(DEVELOPED IN SCOPE OF WORK)

- Obtain, review and integrate existing data and models
- Conduct “desk-top” (i.e., “planning level”) inventory of potential sources of nitrate loading to surface and ground waters
- Review & summarize literature on nitrate loading to surface and ground waters from land uses in the Wekiva basin
- Develop preliminary nitrate budget for the basin (“pie chart”)
- Develop preliminary recommendations for nitrate load reduction strategies
- Develop recommendations for follow-up work (Phase 2)
- Produce report summarizing the above efforts





STUDY AREA WAS THE "WEKIVA BASIN"

- Surface water drainage and "springshed"
- Most technically defensible
- Needed for future modeling efforts
- Needed for Total Max. Daily Load development



WEKIVA BASIN NITROGEN SOURCING STUDY

Data sources:

- SJRWMD land use/land cover data (1999 & 2004)
- East Central Florida Groundwater Model (SJRWMD) – recharge estimates
- Wekiva Study Area stormwater model (WMM)
- Approx. 250 technical publications
- Technical review/guidance by:
 - Del Bottcher, Ph.D. (Soil & Water Engineering Technology, Inc.)
 - Wendy Graham, Ph.D. (University of Florida Dept. of Soil & Water Science and Chair, Florida Water Institute)



NITRATE SOURCES CONSIDERED

- Industrial & Domestic wastewater
- Septic tank drainfields
- Fertilizer
 - Agricultural (row crop, citrus, nurseries, pasture)
 - Residential
 - Golf course
 - ‘Other’ (ball fields, roadside, etc.)
- Livestock
- Atmospheric deposition



PROCEDURAL ISSUES

- Nitrate data were used when available
- Total nitrogen (TN) data used when nitrate not available/reported (assumed to be a surrogate for nitrate)
- Use of reclaimed water for irrigation assumed to replace fertilizer use
- Surface water nitrate loads diverted to stormwater systems assumed to load to ground water



Source Type

Transport Mechanism

Delivered to Wekiva Basin

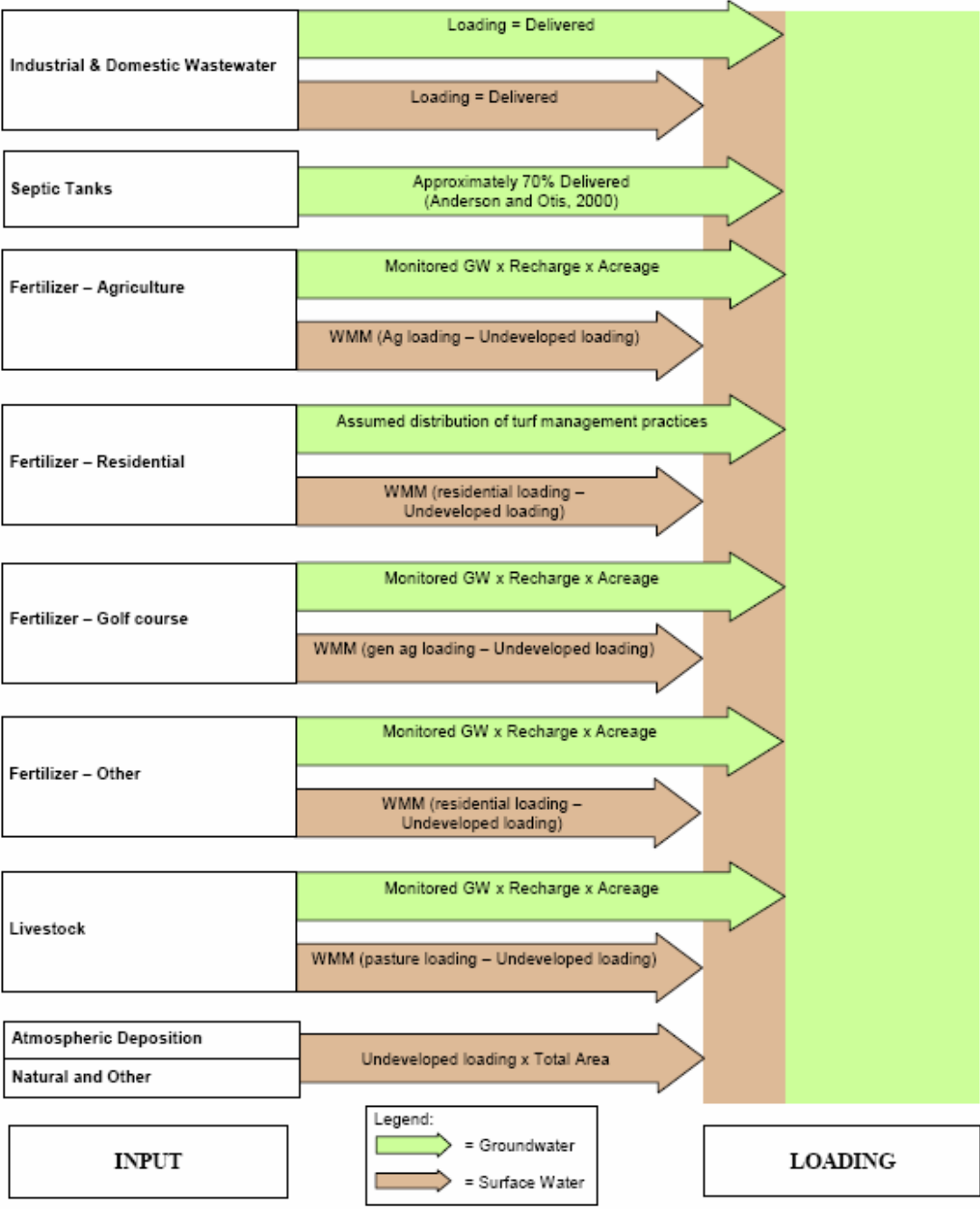
INPUTS

Amount of nitrate applied to the landscape; a.k.a. "what goes on/into the ground"

LOADS

Amount of nitrate delivered to waters of the basin after plant uptake, volatilization, denitrification, etc.

NOTE: stormwater is a transport mechanism, not a "source"



INPUT QUANTIFICATION

- Wastewater – FDEP permit files and discharge monitoring reports
- Septic tank – published literature and FDOH data
- Fertilizer – IFAS recommended application rates (by crop type; turfgrass/lawns; golf course greens). 3 crop rotations/year
- Livestock – estimates of # cattle in basin times cattle waste output
- Atmospheric – CASTNET monitoring data

FDEP – Florida Dept. of Environmental Protection

FDOH – Florida Dept. of Health

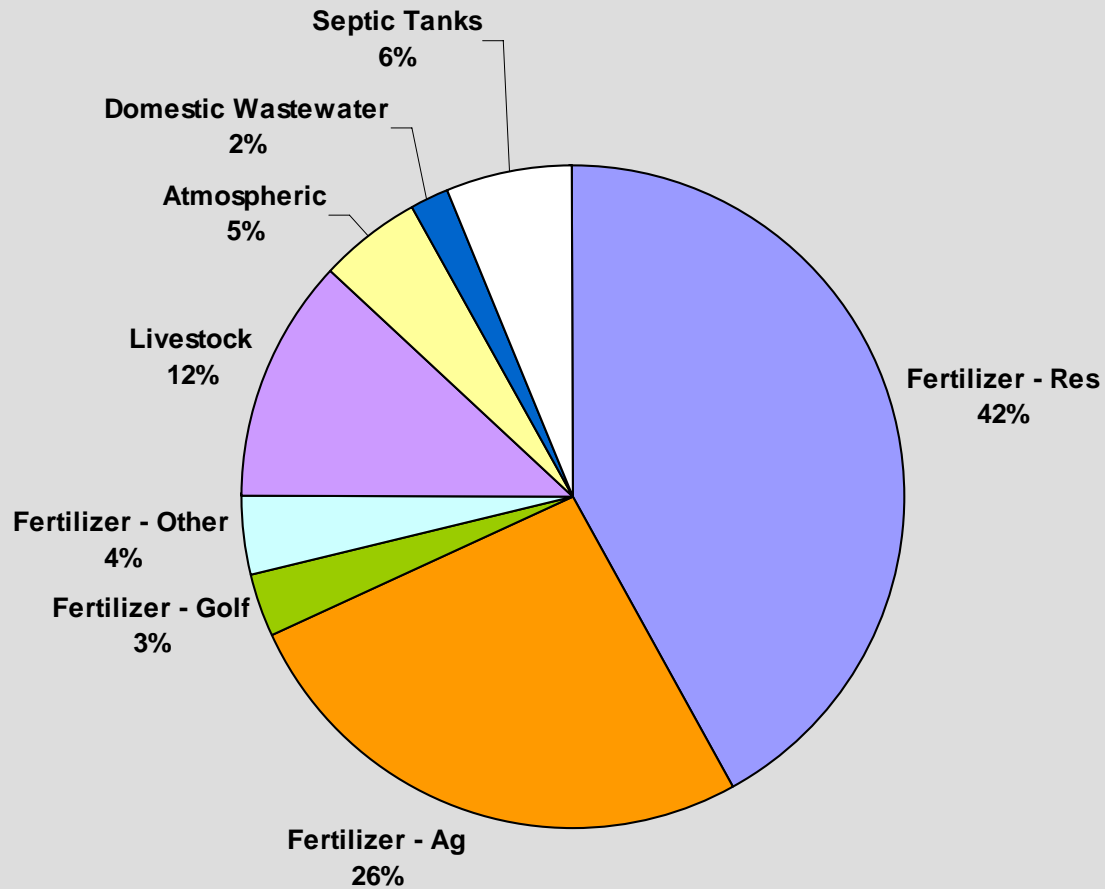
IFAS – Institute of Food and Agricultural Sciences, University of Florida

CASTNET – Clean Air Status and Trends NETwork

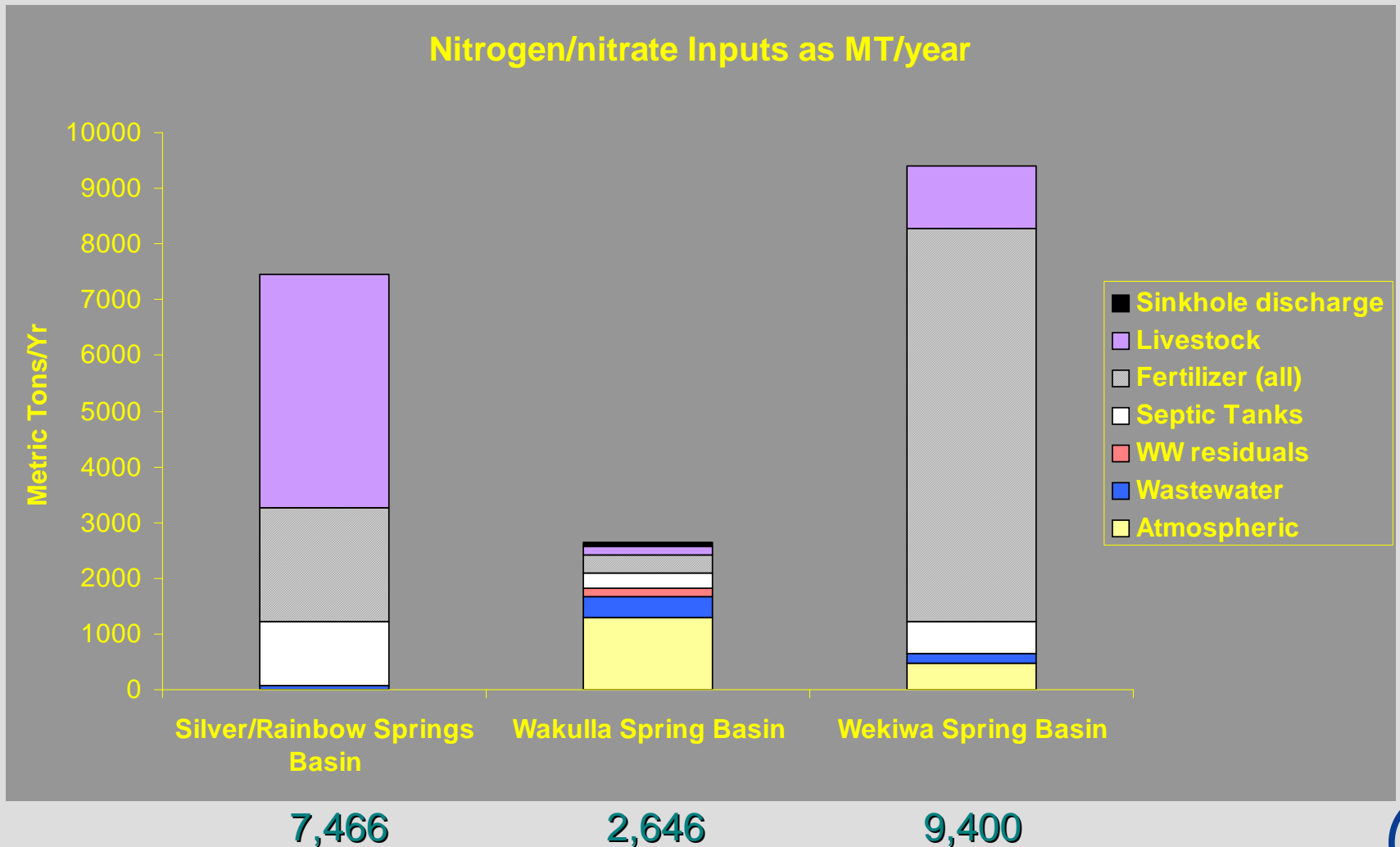


NITROGEN INPUTS (BY SOURCE)

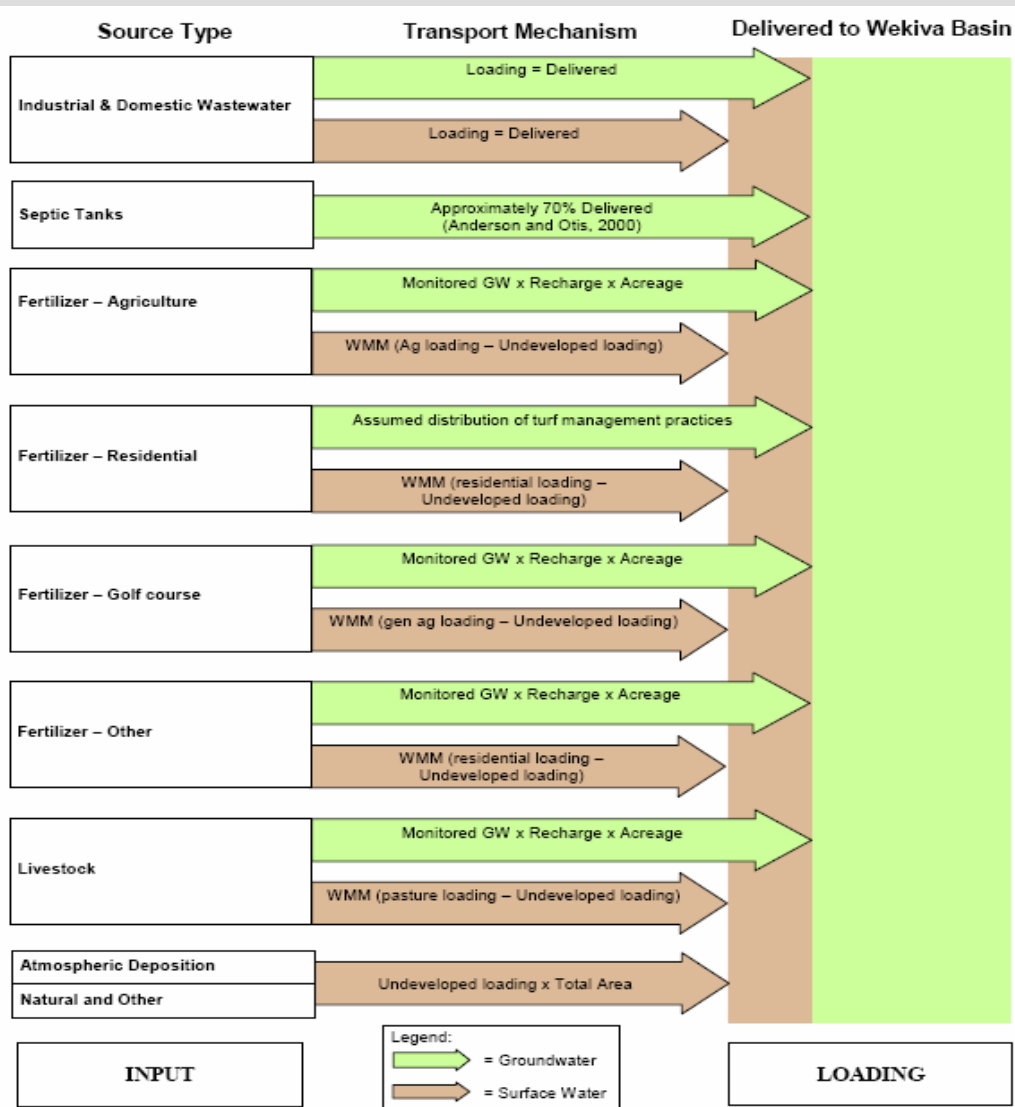
9,400 Metric Tons/Year



NITROGEN INPUTS (BY SOURCE) IN SELECTED SPRING BASINS



LOAD QUANTIFICATION



Wastewater = amount of nitrate delivered to waters of the basin after treatment

Fertilizer = shallow ground water nitrate x recharge rate (=“load”) x landuse

Livestock = shallow ground water nitrate x recharge rate (=“load”) x landuse

Surface water load = WMM model output



LOAD QUANTIFICATION

- Wastewater – published literature and FDEP discharge data
- Septic tank – published literature on drainfield treatment performance; FDOH data & estimated # tanks in the basin (~65,000)
- Fertilizer – published literature on shallow groundwater nitrate concentrations (by land use) combined with recharge estimates (=GW load); stormwater model output (=SW load) & land use
- Livestock – published literature on shallow groundwater nitrate concentrations combined with groundwater recharge estimates (=GW load); stormwater model output (=SW load) & land use
- Atmospheric – CASTNET monitoring data supplemented with estimates from the literature of atmospheric loads in urban areas



LOAD

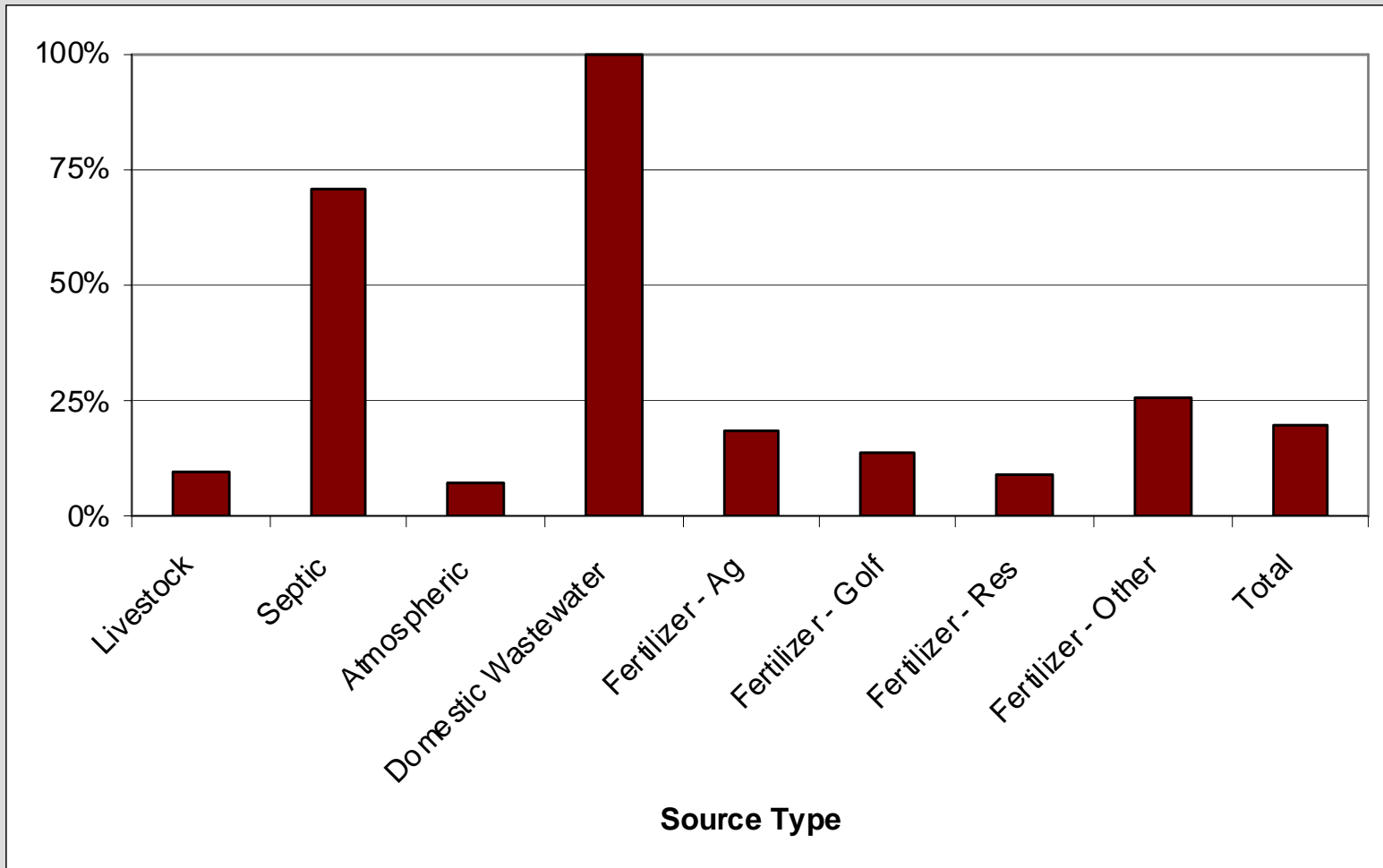
QUANTIFICATION

SHALLOW GROUNDWATER CONCENTRATIONS

- **Agricultural fertilizer**
 - row crops (Florida & SE U.S. studies); 23 mg/L NO₃-N
 - citrus (Florida studies); 6 mg/L NO₃-N
 - ornamental nurseries (several states, including FL); 6 mg/L
- **Agricultural cattle** - 5.5mg/L NO₃-N for pasture (SE U.S. studies). 18 mg/L for CAFO's (Florida studies)
- **Residential fertilizer** – 3 mg/L NO₃-N (25% don't fertilize; 50% use recommended; 25% overfertilize)
- **Golf Course fertilizer** – 8 mg/L NO₃-N

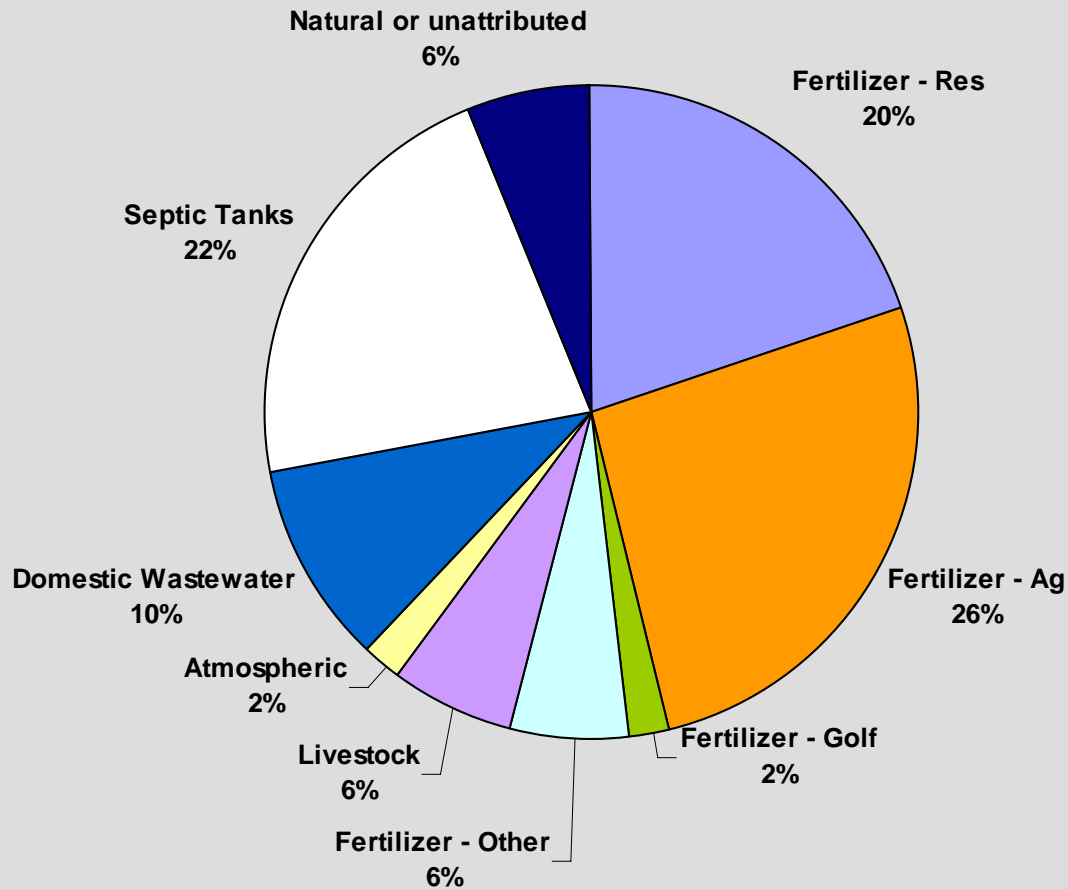


NITRATE - FRACTION THAT REACHES BASIN WATERS



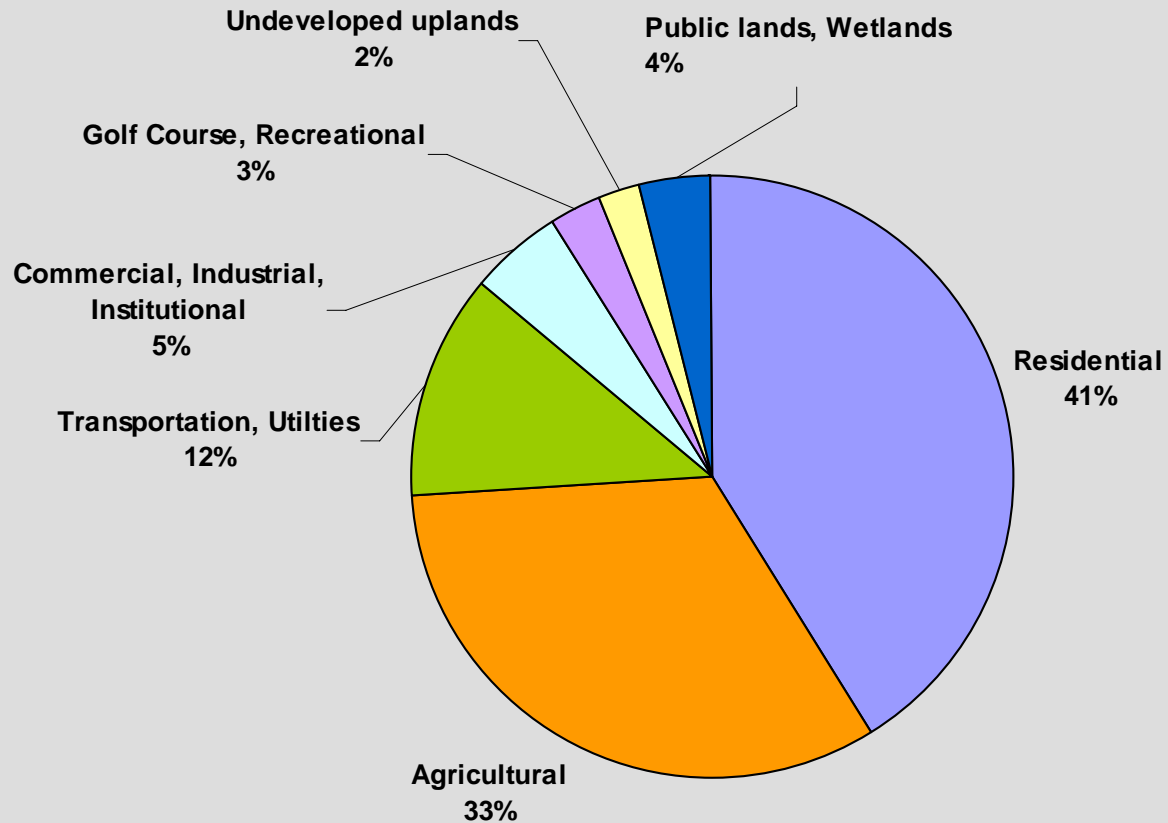
NITRATE LOADS (BY SOURCE)

1,800 Metric Tons/Year



NITRATE LOADS (BY LAND USE)

1,800 Metric Tons/Year



ISSUES TO CONSIDER

- Proximity of loads to springs (Wekiva Study Area focus)
- Loads to shallow groundwater and what gets to the Floridan Aquifer
- Transformation and fate of nitrate in groundwater (esp. when it gets to the Floridan Aquifer)
- “Legacy” nitrogen (loading from past land uses/lag times)
- Assumptions regarding displacement of fertilizer use by wastewater reuse and removal of groundwater nitrate load by stormwater treatment systems



WEKIVA BASIN NITRATE SOURCING STUDY-PHASE 2

- Study of water quality of recharging ground-water, by land use & location likely to have greatest impact on springs
- Development of integrated ground and surface water quality model with potential to simulate $\text{NO}_3\text{-N}$ transformations and transport in runoff, shallow, and deep groundwater compartments; and discharge of groundwater to springs and streams
- Need more data on impacts of residential land uses on shallow and deep ground water



WEKIVA BASIN NITRATE SOURCING STUDY

Funding Summary (\$250,000):

- Initial Work Order with MACTEC - \$49,707.60
- Supplemental work - \$8,782.64
- Total spent with MACTEC - \$58,490.24
- Phase 1 remaining - \$41,509.76
- Phase 2 available - \$191,509.76



? QUESTIONS ?

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